

Programming Useful Life Prediction (PULP), Phase I

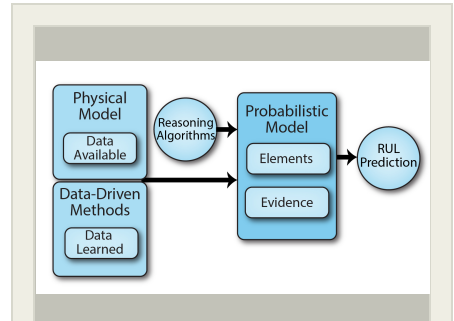
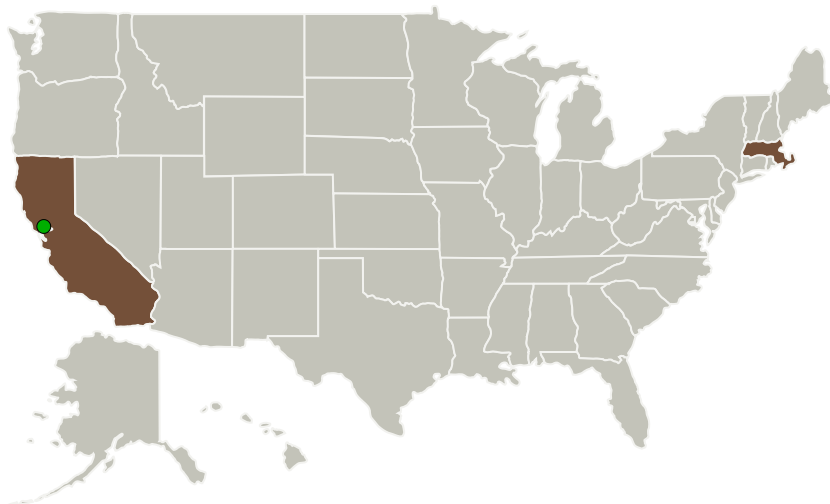
Completed Technology Project (2014 - 2014)



Project Introduction

Accurately predicting Remaining Useful Life (RUL) provides significant benefits—it increases safety and reduces financial and labor resource requirements. Relying on just one methodology for RUL prediction is unsuitable because certain methods of prediction perform better for certain use cases and conditions. Approaches must be combined to maximize accuracy. Encoding these hybrid methods is challenging because their models are complex, change frequently, and represent a wide range of devices, components, and systems. The algorithms associated with these models also require deep mathematical understanding. We propose using probabilistic programming (PP) to integrate physical models and data-driven methods into a probabilistic model that can predict RUL under the Programming Useful Life Prediction (PULP) project. We will use Charles River's Figaro™ probabilistic programming language (PPL) to fuse physical models of critical fault modes and data-driven methods in a hybrid approach to accurately predict the RUL of critical flight systems. Figaro is an ideal solution because it eases construction of Probabilistic Relational Models (PRMs). PRMs can represent a wide range of complex, constantly changing domains that involve uncertainty and require flexibility. Figaro also contains a vast library of reasoning algorithms that can be applied to models, so users do not need deep mathematical expertise.

Primary U.S. Work Locations and Key Partners



Programming Useful Life Prediction (PULP) Project Image

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Organizations Performing Work	Role	Type	Location
Charles River Analytics Inc.	Lead Organization	Industry	Cambridge, Massachusetts
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

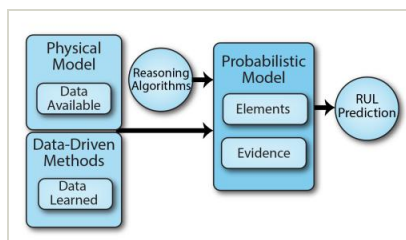
▶ **June 2014:** Project Start

✓ **December 2014:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/137765>)

Images



Project Image

Programming Useful Life Prediction (PULP) Project Image
(<https://techport.nasa.gov/image/133111>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Charles River Analytics Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

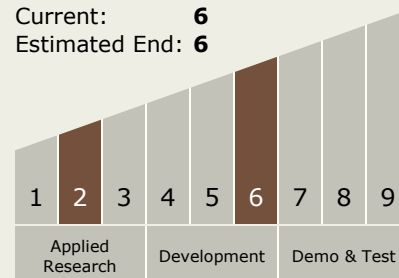
Carlos Torrez

Principal Investigator:

Avi Pfeffer

Technology Maturity (TRL)

Start: 2
Current: 6
Estimated End: 6



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Technology Areas

Primary:

- TX13 Ground, Test, and Surface Systems
 - └ TX13.2 Test and Qualification
 - └ TX13.2.6 Advanced Life-Cycle Testing Techniques

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System